



Service Manual

Blood Bank Refrigerator

FILE No.

MBR-305D
MBR-305DR
MBR-305GR

SANYO Electric Co., Ltd.
Biomedical Business Division



SM9910226

Effective models

This service manual is effective following models.

Model name	Model code	Voltage and Frequency	
MBR-305D	823 628 62	220V	50Hz
MBR-305DR	823 628 72	220V	50Hz
MBR-305GR	823 628 51	115V	60Hz
	823 628 53	220V	60Hz
	823 628 54	220-240V	50Hz

Contents

Specifications	-----	1
- Structural specifications		
- Control specifications		
- Performance specifications		
• Dimensions	-----	4
• Refrigeration circuit	-----	7
• Cooling unit parts	-----	8
• Specification of sensor	-----	9
• Components on PCB	-----	10
• Connection on PCB	-----	11
• Electric parts	-----	12
• Wiring diagram	-----	14
• Circuit diagram (Main PCB)	-----	15
• Circuit diagram (Control PCB)	-----	16
• Control specifications	-----	17
• Parts layout	-----	32
• Test data	-----	33
- Pull-down speed		
- Pull-up speed		
- Pull-down pressure		
- Pull-down current-input		
- Temperature uniformity (15points measured)		
- Amount of power consumption		
- Maximum heat discharge		
• Instruction manual	-----	38

Specifications

Structural specifications

Model	MBR-305D	MBR-305DR	MBR-305GR
External dimensions	W600 x D680 x H1835 (mm)		
Internal dimensions	W520 x D490 x H1150 (mm)		
Effective capacity	304 L	302 L	
Exterior	Painted steel		
Interior	Painted steel		
Insulation	Rigid polyurethane foamed-in place		
Outer door	1 door, Painted steel, provided with 2-layer glass window		
Inner door	2 doors, Acrylic resin		
Outer door lock	1		
Shelf	5, Hard steel wire on polyester coating Allowable load; 20kg/pc	_____	
Drawer	_____	5, Stainless steel Allowable load; 20kg/pc	
Caster	4 pcs (2 leveling legs on front)		
Access port	1 at left side, Inner diameter; 30mm		
Cooling method	Forced cool air circulation		
Evaporator	Fin and tube type		
Condenser	Wire and tube type		
Compressor	1, Hermetic type, output: 150W		
Compressor oil	α 15HT		
Refrigerant	R-134a		
Illumination	1 fluorescent lamp		
Weight	132 kg	147 kg	
Accessories	1 set of key		
Optional components	Interface board (MTR-480) Basket (MBR-35B, MBR-55B, MBR-55BL)		

Control specifications

Model		MBR-305D	MBR-305DR	MBR-305GR
Temperature controller		Electronic control system Sensor : Thermistor		
Temperature display		LED digital (Unit; 0.1°C)		
Alarm	High temp.	When chamber temp. is higher than set temp. +6°C (Factory default), ALARM lamp blinks and audible alarm sounds intermittently. Audible alarm sounds again after 30 min. elapse if unit keeps alarming condition. Setting range; +5.0 ~ +9.0°C		
	Low temp.	When chamber temp. is lower than set temp. -2°C (Factory default), ALARM lamp blinks and audible alarm sounds intermittently. Audible alarm sounds again after 30 min. elapse if unit keeps alarming condition. Setting range; -1.0 ~ -4.0°C		
	Door	DOOR lamp illuminates and audible buzzer sounds intermittently after 2 min. elapses.		
	Power failure	ALARM lamp blinks and audible alarm sounds intermittently for 24 hours.		
	Remote alarm	DC30V, MAX 2A, N.O.-COM. N.C.-COM. Remote alarm activates when unit is in alarming condition and in power failure.		
Notice of battery life		When battery accumulation time expires about 3 years (2 years and 10 months), 'F-1' and chamber temperature are alternately displayed. Audible alarm and remote alarm do not activate.		
Notice of fan motor life		When condensing fan motor accumulation time expires about 6 years (5 years and 8 months), 'F-2' and chamber temperature are alternately displayed. Audible alarm and remote alarm do not activate. Note) Notice of fan motor life can be set alternate ON/OFF in F43.		
Temperature protection		Heater turns off and compressor turns on when temperature in mechanical high temp. alarm thermostat is higher than +12°C. Compressor turns off and heater turns on when temperature in low temp. alarm sensor is lower than +2°C.		
Defrosting		Cycle defrost + forced defrost Sensor; Thermistor (Type;502AT-1)		
Control panel		ALARM: Alarm indicator DOOR: Door check indicator UPPER: Temperature display indicator LOWER: Temperature display indicator BUZZER: Alarm buzzer stop key ALARM TEST: Alarm test key UPPER/LOWER: Temperature display changeover key CAL: Calibration key ▶▶ : Scroll key ▲ : Up arrow key		
Self diagnosis function		When temp. sensor or defrost sensor is failed; Error code and chamber temperature are displayed alternately. Remote alarm contact activates and audible alarm sounds.		
Compressor protection		Overload relay When comp. sensor detects fan motor lock, compressor forcibly turns off before overload activates.		

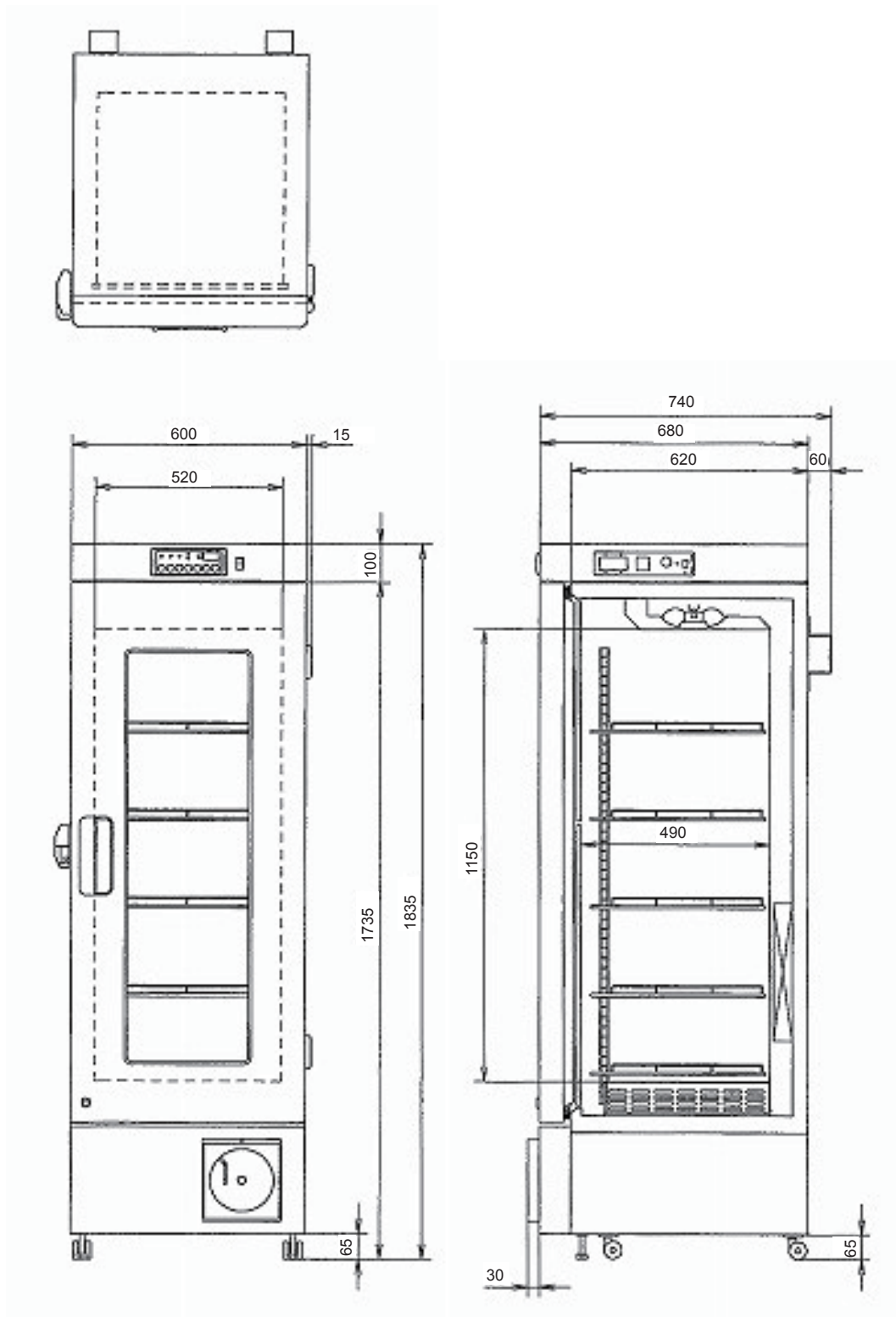
Performance specifications

Model	MBR-305D		MBR-305DR		MBR-305GR
Storage temperature	4°C (AT; +35°C)				
Temperature distribution	+/- 1.5°C				
Noise level	41 dB (A scale, 50/60Hz)				
Maximum pressure	1850 kPa				
Rated voltage	AC115V	AC220V	AC220V	AC230V	AC240V
Rated frequency	60Hz	60Hz	50Hz	50Hz	50Hz
Power consumption	230W	220W	205W	210W	220W

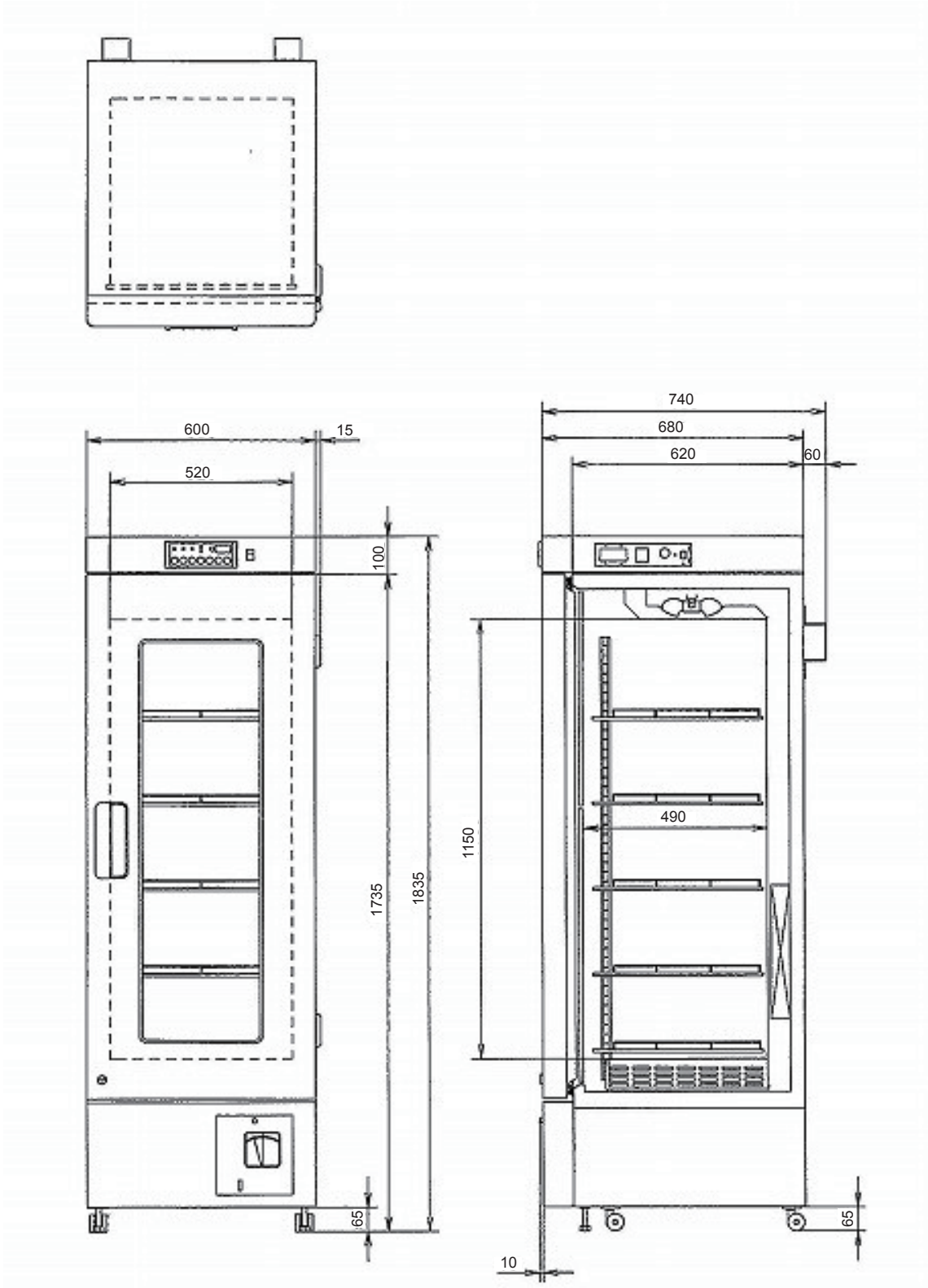
Note) Design or specifications will be subject to change without notice.

Dimensions

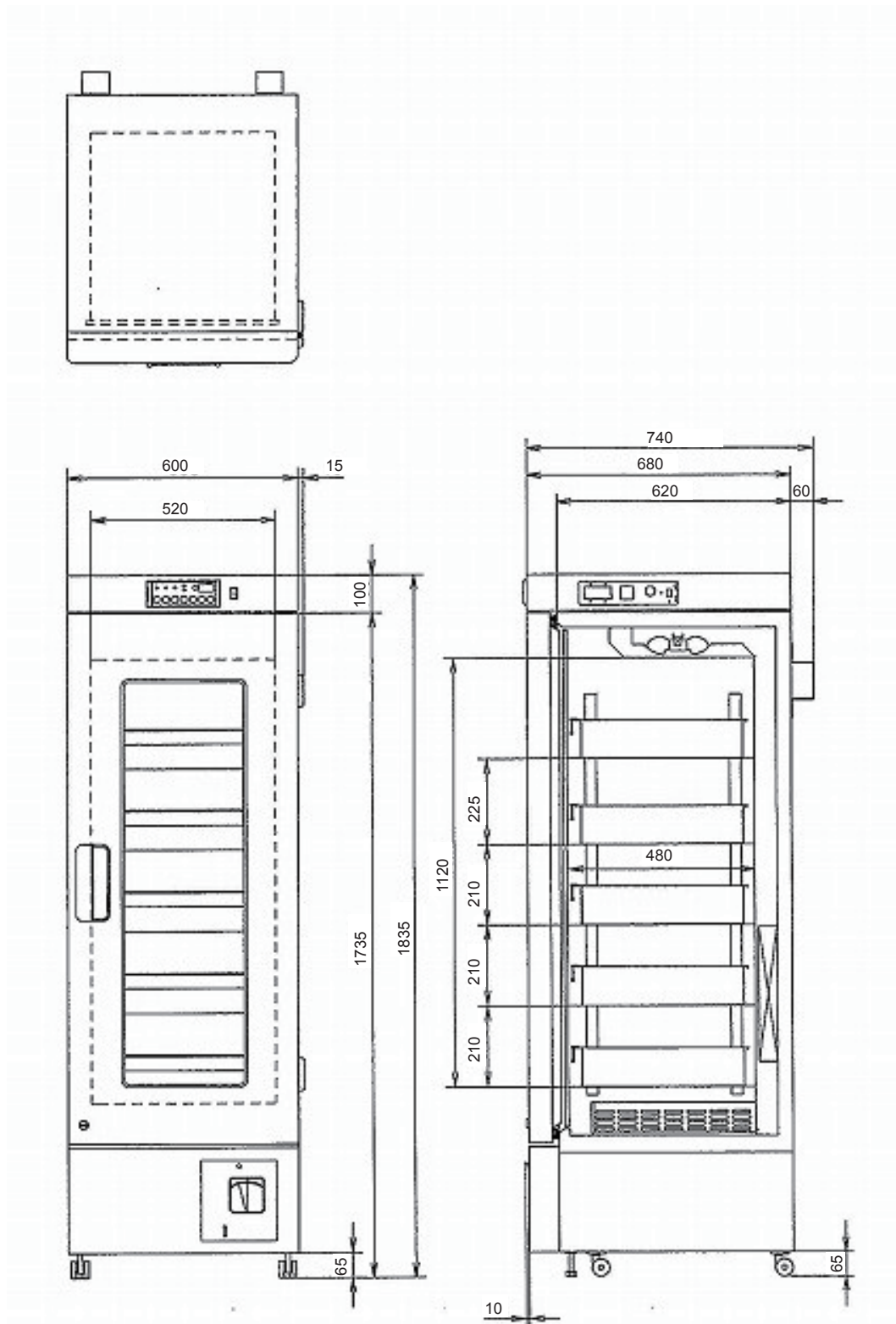
<MBR-305GR>



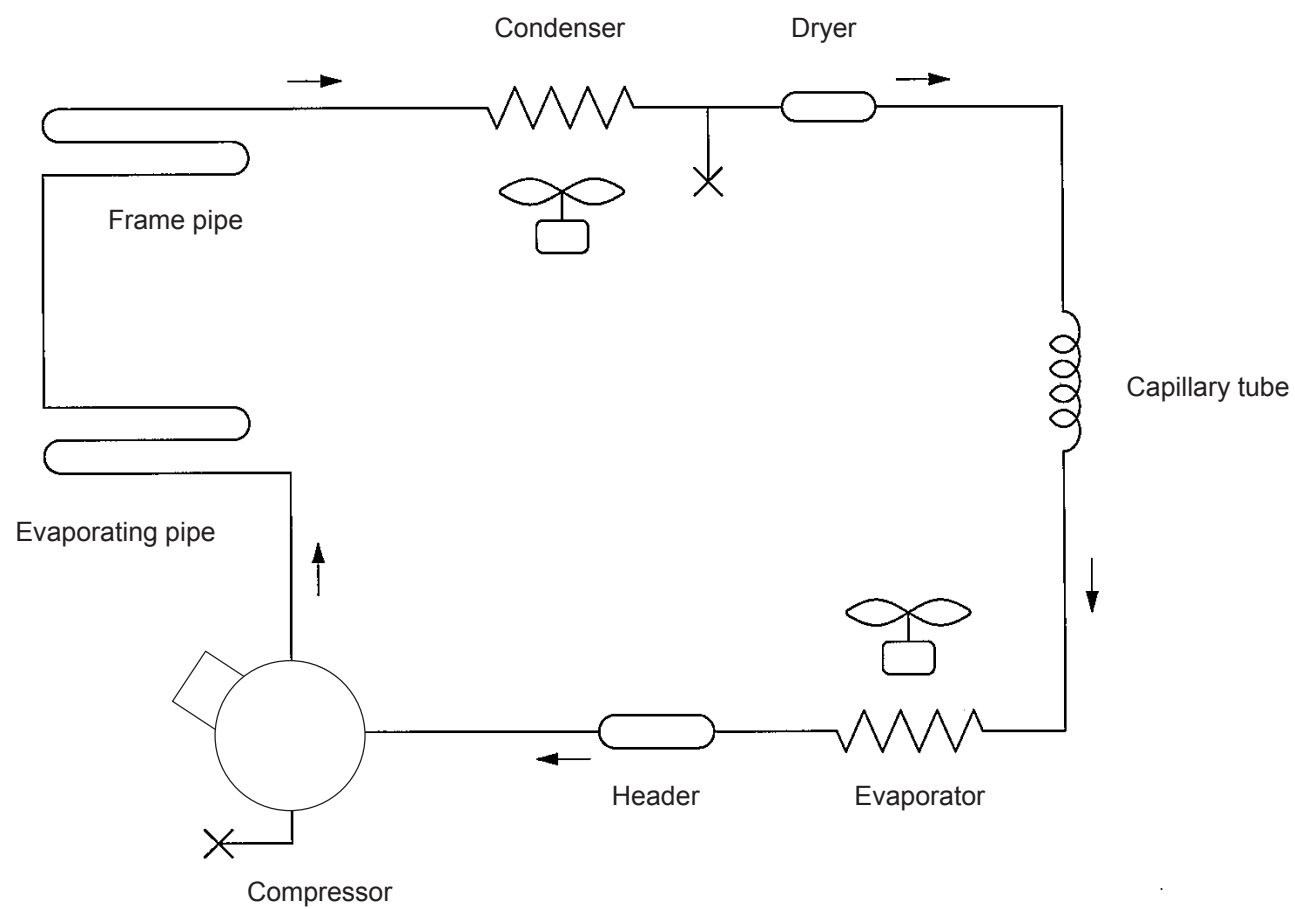
<MBR-305D>



<MBR-305DR>



Refrigeration circuit



×... Evacuation points

Cooling unit parts

Parts descriptions	Specifications		
	MBR-305D	MBR-305DR	MBR-305GR
Compressor			
	For 115V, 60Hz		
Type	FL1568-PD		
Compressor code	7FB-0-M101-010-02		
Rated power supply	Single phase, 110/115V, 60Hz		
Refrigeration oil	Type: α 15HT Charged q' ty: 310+/-10 ml		
Cooling method	Forced cool air circulation		
	For 220/230/240V, 50Hz		
Type	FL1568-SP		
Compressor code	7FB-0-M101-010-03		
Rated power supply	Single phase, 220-240V, 50Hz		
Refrigeration oil	Type: α 15HT Charged q' ty: 310+/-10 ml		
Cooling method	Forced cool air circulation		
	For 220V, 60Hz		
Type	FL1568-RB		
Compressor code	7FB-0-M101-010-04		
Rated power supply	Single phase, 220V, 60Hz		
Refrigeration oil	Type: α 15HT Charged q' ty: 310+/-10 ml		
Cooling method	Forced cool air circulation		
Condenser			
Type	Wire and tube		
	ϕ 4.76 x P20 x W150 mm 11columns, Wire(P)6, 154pcs		
Evaporating pipe	ϕ 6.35 x T0.7 x W330 mm		
Frame pipe	ϕ 4.0 x T0.5		
Evaporator			
Type	Fin and tube		
	ϕ 8.0 x P5 x W380 mm, 6columns x 2lines, Fin; 75pcs.		
Capillary tube			
Resistance	122 PSI		
Length	2000 mm		
Outer diameter	ϕ 1.8 mm		
Inner diameter	ϕ 0.8 mm		
Refrigerant			
Type	R-134a Charge q' ty: 160 g		
Dryer			
Type	4AXH-9 Charge q' ty: 10 g		
Condensing fan motor			
	For 115V, 60Hz		
Type	FL2-D021R1MP	ϕ 160, 4pcs. Material: ABS	Output: 2W
	For 220/230/240V, 50Hz		
Type	FL2-D021R5MP	ϕ 160, 4pcs. Material: ABS	Output: 2W
	For 220V, 60Hz		
Type	FL2-D021R5MP	ϕ 160, 4pcs. Material: ABS	Output: 2W
Cooling fan motor			
	For 115V, 60Hz		
Type	FU2-C051B1MP	ϕ 160, 4pcs. Material: PPGF	Output: 5W
	For 220/230/240V, 50Hz		
Type	FU2-C051B5MP	ϕ 160, 4pcs. Material: PPGF	Output: 5W
	For 220V, 60Hz		
Type	FU2-C051B5MP	ϕ 160, 4pcs. Material: PPGF	Output: 5W

Specifications of sensor

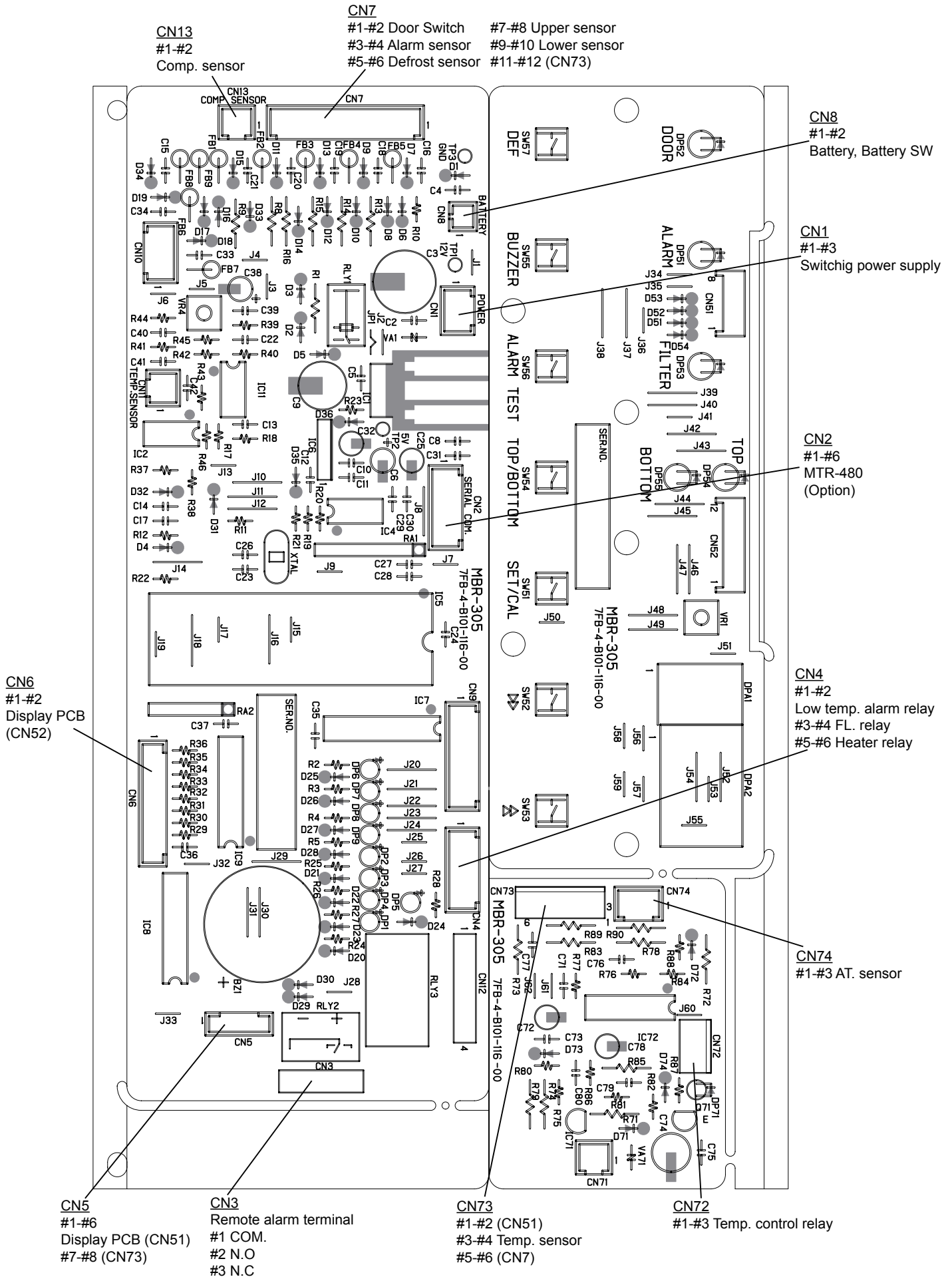
■Temperatures and references in thermistor (Type: 502AT-1)

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
-50	154.50	-7	17.92	12	8.17
-45	116.50	-6	17.16	13	7.85
-40	88.85	-5	16.43	14	7.55
-35	68.15	-4	15.74	15	7.27
-30	52.84	-3	15.08	16	6.99
-25	41.19	-2	14.45	17	6.73
-20	32.43	-1	13.86	18	6.48
-19	30.92	0	13.29	19	6.24
-18	29.50	1	12.74	20	6.01
-17	28.14	2	12.22	25	5.00
-16	26.87	3	11.72	30	4.18
-15	25.65	4	11.25	35	3.51
-14	24.51	5	10.80	40	2.96
-13	23.42	6	10.37	45	2.51
-12	22.39	7	9.96	50	2.14
-11	21.41	8	9.57	55	1.83
-10	20.48	9	9.20	60	1.57
-9	19.58	10	8.84		
-8	18.73	11	8.49		

■Temperatures and references in temp. sensor (Type:PT100Ω- NEW JIS)

Temp. (°C)	Resistance (Ω)	Temp. (°C)	Resistance (Ω)	Temp. (°C)	Resistance (Ω)	Temp. (°C)	Resistance (Ω)
-170	31.32	-100	60.25	-30	88.22	40	115.54
-160	35.79	-90	64.30	-20	92.16	50	119.40
-150	39.82	-80	68.33	-10	96.09	60	123.24
-140	43.87	-70	72.33	0	100.00	70	127.07
-130	48.00	-60	76.33	10	103.90	80	130.89
-120	52.11	-50	80.31	20	107.80	90	134.70
-110	56.19	-40	84.27	30	116.70	100	138.50

Components on PCB



Connections on PCB

■ Connections on Main PCB

Connector	Connect to	Usage
CN1	Switching power supply #1: +12VDC #3: GND	To supply power to PCB
CN2	MTR-480 (Option)	
CN3	Remote alarm terminal #1: COM. #2: N.O. #3: N.C.	To output for remote alarm contact
CN4	#1 - #2: Low temp. alarm relay #3 - #4: FL relay #5 - #6: Heater relay	To operate low temp. cycle To link between FL. Lamp and door To supply power to main heater
CN5	#1 - #6: Display PCB (CN51) #7 - #8: Control PCB (CN73)	To connect with each switch
CN6	#1 - #12: Display PCB (CN52)	To connect with each LED
CN7	#1 - #2 : Door switch #3 - #4 : Alarm sensor #5 - #6 : Defrost sensor #7 - #8 : Upper sensor #9 - #10 : Lower sensor #11 - #12 : Control PCB (CN73)	To detect door opening To detect low temp in chamber To detect frosting in chamber To detect upper bottle temperature To detect lower bottle temperature
CN8	#1 - #2: Battery, Battery switch	To control battery ON/OFF
CN13	#1 - #2: Comp. sensor	To detect fan motor lock

■ Connections on Control PCB

Connector	Connect to	Usage
CN71	#1 - #2: Switching power supply	To supply power to PCB
CN72	#1 - #3: Temp. control relay	To control chamber temperature
CN73	#1 - #2: Display PCB (CN51) #3 - #4: Temp. sensor #5 - #6: Main PCB (CN7)	To detect chamber temperature
CN74	#1 - #3: AT sensor	To detect ambient temperature



Electric Parts

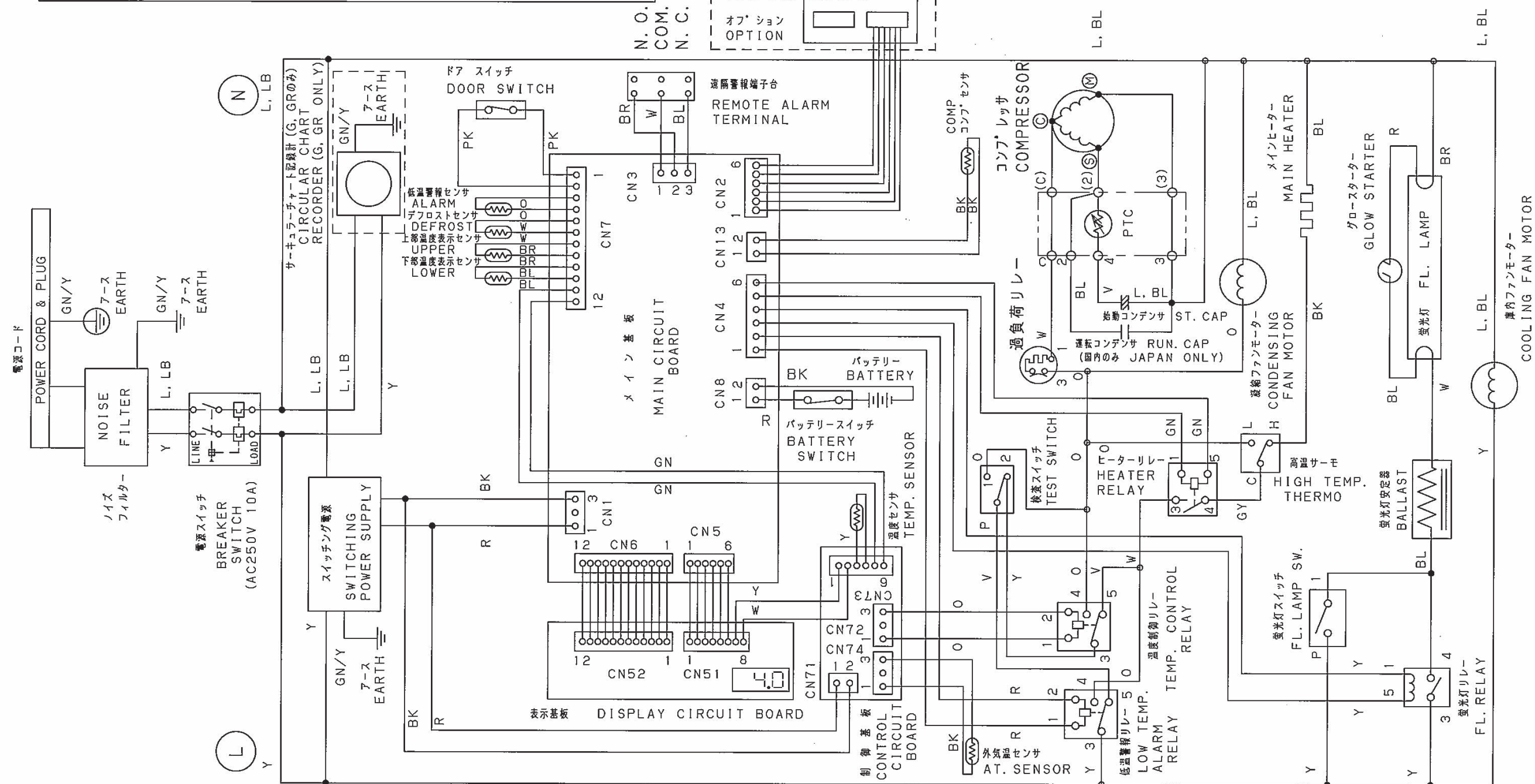
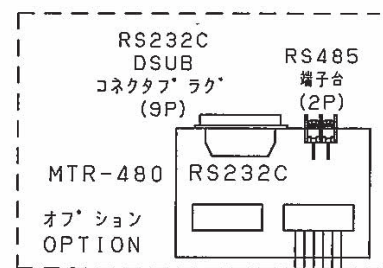


MBR-305D/305DR/305GR		AC115V, 60Hz	AC220~240V, 50Hz	AC220V, 60Hz
Compressor	Type	FL1568-PD	FL1568-SP	FL1568-RB
	Code	7FB-0-M101-010-02	7FB-0-M101-010-03	7FB-0-M101-010-04
	Rated voltage (50/60Hz)	φ 1, 110/115V, 60Hz	φ 1, 220-240V, 50Hz	φ 1, 220V, 60Hz
	Winding resistance C-R(Main)	2.16 Ω	11.4 Ω	8.64 Ω
	C-S(Aux)	4.56 Ω	19.5 Ω	9.23 Ω
PTC	Type	P5R0SAT	PGR0SAT	PER0SAT
Overload relay	Type	4.0C36C1	2.0C36C3	2.0C36C3
	Action to the temp. (No current)			
	OFF	130+8/-9°C	130+8/-9°C	130+8/-9°C
	ON	60+7/-5°C	60+7/-5°C	60+7/-5°C
	Action to the current (AT25°C)	12.2A	7.6A	7.6A
	Operation time	10 sec	10 sec.	10 sec.
Starting capacitor	Rating	120μF 160VAC	60μF 300VAC	60μF 300VAC
Cooling fan motor	Type	FU2-C051B1MP	FU2-C051B5MP	FU2-C051B5MP
	Rating	115V	220-240V	220-240V
Condensing fan motor	Type	FL2-D021R1MP	FL2-D021R5MP	FL2-D021R5MP
	Rating	110V	220-240V	220-240V
Main heater	Rating	50W	50W	50W
Heater relay	Type	G2R-1A-T	G2R-1A-T	G2R-1A-T
	Contact capacity	10A, 250V	10A, 250V	10A, 250V
	Coil	12VDC	12VDC	12VDC
Temp. control relay	Type	G4F-1123T	G4F-1123T	G4F-1123T
	Contact capacity	20A, 250V	20A, 250V	20A, 250V
	Coil	12VDC	12VDC	12VDC
Low temp. alarm relay	Type	G4F-1123T	G4F-1123T	G4F-1123T
	Contact capacity	20A, 250V	20A, 250V	20A, 250V
	Coil	12VDC	12VDC	12VDC
FL relay	Type	G2R-1A-T	G2R-1A-T	G2R-1A-T
	Contact capacity	10A, 250V	10A, 250V	10A, 250V
	Coil	12VDC	12VDC	12VDC
High temp.thermo	Type	WP9K-114-011	WP9K-114-011	WP9K-114-011
	Rating	250V	250V	250V
Fluorescent lamp	Type	FL15SD	FL15SD	FL15SD
	Rating	15W	15W	15W
Glow starter	Type	FG-1P	FG-1P	FG-1P
Ballast	Type	FCB-1587115A	FCB-152022/2	FCB-152022/2
	Rating	15W, 115V, 60Hz	15W, 220V, 60Hz	15W, 220V, 60Hz

Temp. sensor	Type	TRP-2-SP-REG	TRP-2-SP-REG	TRP-2-SP-REG
	Rating	PT100Ω	PT100Ω	PT100Ω
AT sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Comp. sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Lower sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Upper sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Defrost sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Alarm sensor	Type	502AT	502AT	502AT
	Rating	5KΩ 25°C	5KΩ 25°C	5KΩ 25°C
Switching power supply	Type	ZWS10-12/J	ZWS10-12/J	ZWS10-12/J
	Rating	DC12V, 0.85A	DC12V, 0.85A	DC12V, 0.85A
Battery switch	Type	SLE6A2-5	SLE6A2-5	SLE6A2-5
	Rating	4A, 250VAC	4A, 250VAC	4A, 250VAC
Battery	Type	5HR-AAC	5HR-AAC	5HR-AAC
	Rating	6V, 1100MAH	6V, 1100MAH	6V, 1100MAH
Breaker switch	Type	BAM210131	BAM210131	BAM210131
	Rating	250V, 10A	250V, 10A	250V, 10A
Door switch	Type	SDKNA20700	SDKNA20700	SDKNA20700
	Rating	5V, 5MA	5V, 5MA	5V, 5MA
FL lamp switch	Type	MS152W1-A01	MS152W1-A01	MS152W1-A01
	Rating	DC8V, 1A	DC8V, 1A	DC8V, 1A
Test switch	Type	SLE6D2-5	SLE6D2-5	SLE6D2-5
	Rating	4A, 250VAC	4A, 250VAC	4A, 250VAC
Noise filter	Type	ZHG2210-11S	ZHG2210-11S	ZHG2210-11S
	Rating	10A, 250VAC	10A, 250VAC	10A, 250VAC

Wiring diagram

BL : 青 BLUE	GY : 灰 GRAY	PK : 桃 PINK
BK : 黒 BLACK	O : 橙 ORANGE	R : 赤 RED
BR : 茶 BROWN	W : 白 WHITE	L. BL: 空 LIGHT BLUE
GN : 緑 GREEN	Y : 黄 YELLOW	V : 紫 VIOLET



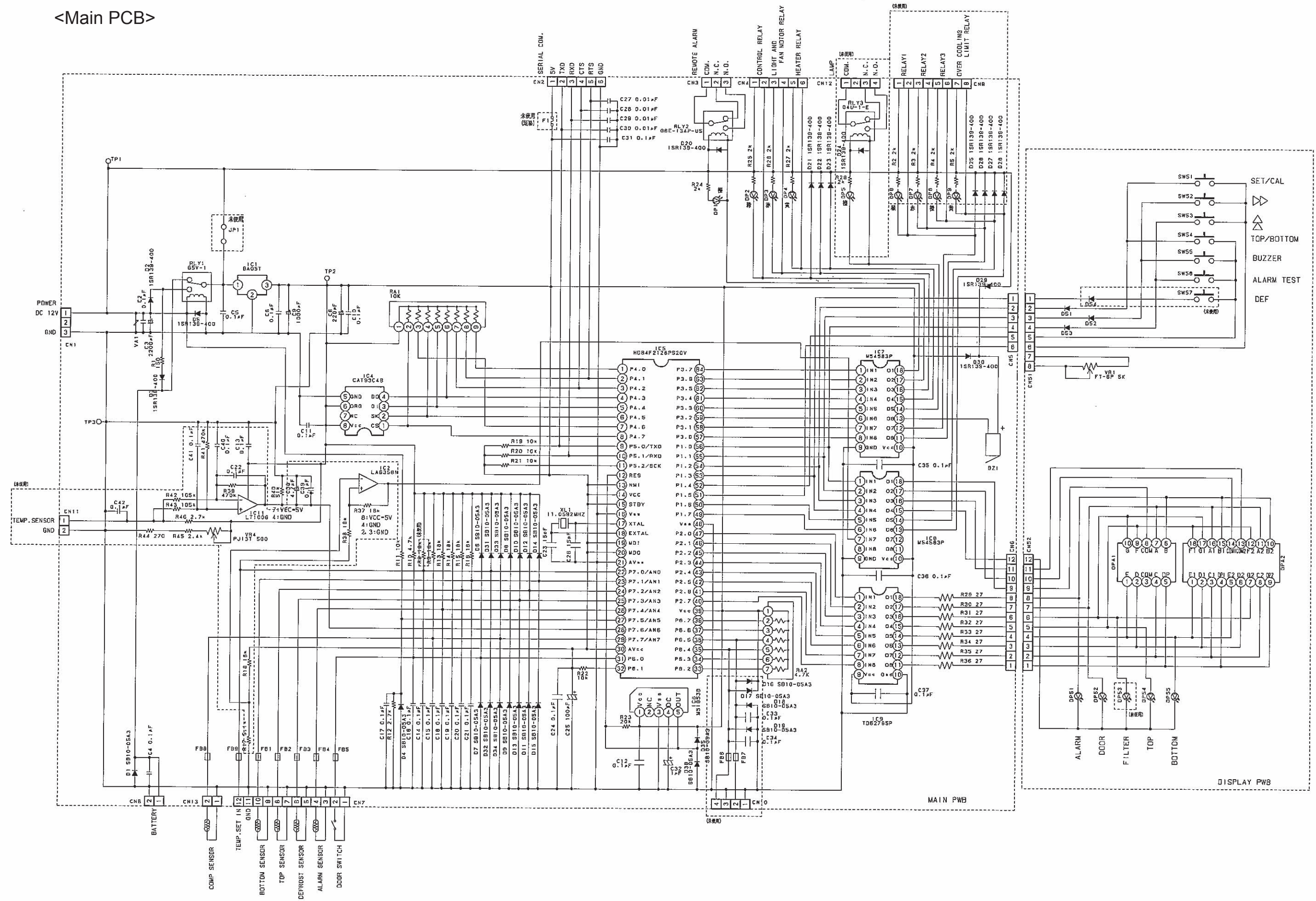
7FB-6-P441-333-00-1

MBR-305D, DR, G, GR

CIRCUIT DIAGRAM 電気回路図

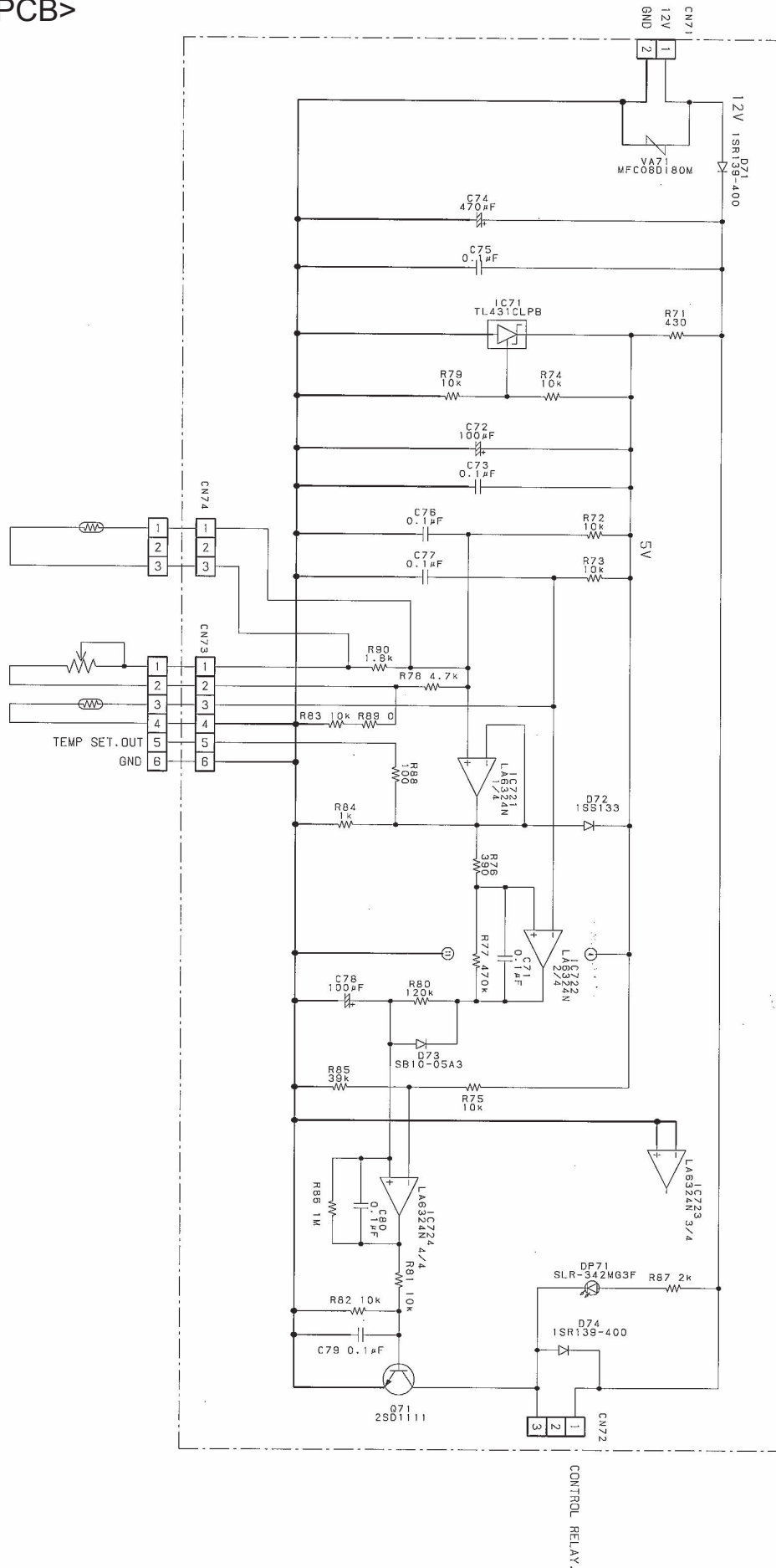
Circuit diagram

<Main PCB>



Circuit Diagram

<Control PCB>



Control specifications

1. Keys on control panel

- BUZZER** : When a unit is in alarming condition, press this key to stop audible alarm sounding and to turn remote alarm off.
Alarm message remains to display.
This key is inoperative during an alarm test performs.
- UPPER/LOWER** : Display temperature is changed to the following order every time pressing this key.
Mean temp. (Factory default) => Upper bottle temp. => Lower bottle temp. => Mean temp. ...
- ALARM TEST** : Press this key to perform an alarm test.
ALARM lamp blinks, audible alarm sounds and remote alarm contact turns on.
If there are no key operations for 90 seconds, a unit has alarm test come to the end.
If this key is pressed during alarm test performs, a unit has alarm test come to the end.
This key is inoperative when a unit is actually in alarming condition.
- CAL** : Press this key for 5 seconds to step to calibration mode (C-mode).
This key acts as 'Enter key' during a unit is in C-mode or function mode (F-mode).
- ▶▶ (Scroll key)** : This key is used in C-mode and F-mode. Press this key to shift digit to be changed.
- ▲ (Up arrow key)**: This key is used in C-mode and F-mode. Press this key to change numerical value.

2. Temperature setting and function

(1) Temperature setting

- Setting range: +2.0 ~ +9.0°C (Turn a volume on control panel)
- How to set: Step to F-mode, 'F38' to display setting temperature in control PCB.
Turn a volume, 'VR1' to set temperature.
Press CAL key to return to chamber temperature display.

Ex.) If a measured temperature will be set to 4.0°C when it is actually 3.6°C while a display temperature in F38 is '4.0', turn 'VR1' until the display temperature will be '4.4'.

Note) If you turn VR1 without displaying control PCB temperature, it may be caused to change temperature setting.

(2) Function mode (F-mode)

Setting range: 0 ~ 45

Display range: 0 ~ 49

(05, 07, 08, 10, 18~20, 23, 24, 26~29, 31, 39~42, 46~49 are unused.)

How to set: In chamber temperature display, press ▲ key for 5 seconds to step to function mode and 'F00' is displayed with 1st digit blinks.

Change a value by pressing ▲ key and ►► key.

Press CAL key to activate function mode.

Unacceptable setting range: If a value which is out of setting range is input and CAL key is pressed, error tone emits and setting will not be changed.

(3) Calibration mode (C-mode)

Setting range: 0 ~ 4

Display range: 0 ~ 4

How to set: In chamber temperature display, press ▲ key for 5 seconds to step to calibration mode and 'C00' is displayed with 1st digit blinks.

Change a value by pressing ▲ key and ►► key.

Press CAL key to activate calibration mode.

Unacceptable setting range: If a value which is out of setting range is input and CAL key is pressed, error tone emits and setting will not be changed.

3. Error codes and Notice

E03:	Defrost sensor is open circuited
E04:	Defrost sensor is short circuited
E05:	Comp. sensor is open circuited
E06:	Comp. sensor is short circuited
E10:	Compressor temperature is abnormal
E13:	Alarm sensor is open circuited
E14:	Alarm sensor is short circuited
E15:	Upper sensor is open circuited
E16:	Upper sensor is short circuited
E17:	Lower sensor is open circuited
E18:	Lower sensor is short circuited
E2P:	Unit fails to write data in non-volatile memory
F-1:	Notice of battery life
F-2:	Notice of condensing fan motor life

Following shows the descriptions of error codes and notices.

- E03: When a temperature in defrost sensor is lower than -60°C, a unit diagnoses that the sensor is open circuited and 'E03' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time the unit does not perform defrosting.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E03 emits.

- E04: When a temperature in defrost sensor is higher than +60°C, a unit diagnoses that the sensor is short circuited and 'E04' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time the unit does not perform defrosting.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E04 emits.
- E05: When a temperature in comp. sensor is lower than -60°C, a unit diagnoses that the sensor is open circuited and 'E05' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E05 emits.
- E06: When a temperature in comp. sensor is higher than +60°C, a unit diagnoses that the sensor is short circuited and 'E06' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E06 emits.
- E10: When a temperature in comp. sensor is higher than +57°C, a unit diagnoses that fan motor is locked.
E10' and chamber temperature are displayed alternately, and both compressor and heater are turned off.
At the time audible alarm and remote alarm do not activate.
Compressor and heater turn on as soon as a temperature in comp. sensor will be lower than 45°C.
- E13: When a temperature in alarm sensor is lower than -60°C, a unit diagnoses that the sensor is open circuited, and 'E13' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
Temperature alarm is controlled by chamber temperature (temperature in upper/lower sensor).
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E13 emits.
- E14: When a temperature in alarm sensor is higher than +60°C, a unit diagnoses that the sensor is short circuited, and 'E14' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
Temperature alarm is controlled by chamber temperature (temperature in upper/lower sensor).
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E14 emits.
- E15: When a temperature in upper sensor is lower than -60°C, a unit diagnoses that the sensor is open circuited, and 'E15' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time a unit cannot detect high and low temperature alarm.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E15 emits.

- E16: When a temperature in upper sensor is higher than +60°C, a unit diagnoses that the sensor is short circuited, and 'E16' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time a unit cannot detect high and low temperature alarm.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E16 emits.
- E17: When a temperature in lower sensor is lower than -60°C, a unit diagnoses that the sensor is open circuited, and 'E17' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time a unit cannot detect high and low temperature alarm.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E17 emits.
- E18: When a temperature in lower sensor is higher than +60°C, a unit diagnoses that the sensor is short circuited, and 'E18' and chamber temperature are displayed alternately. Audible alarm sounds and remote alarm activates.
At the time a unit cannot detect high and low temperature alarm.
By pressing BUZZER key to cancel operations for audible alarm and remote alarm when E18 emits.
- E2P: When a unit fails to write data in non-volatile memory, 'E2P' and chamber temperature are displayed alternately.
Audible alarm and remote alarm do not activate.
- F-1: When battery accumulation time expires about 3 years (1022days), 'F-1' and chamber temperature are alternately displayed.
Unit starts counting accumulation time every 24 hours elapse since a power is supplied.
Audible alarm and remote alarm do not activate.
Input '409' in F06 and press CAL key to reset accumulation time to '0'.
If a unit forcibly turns off before 24 hours elapse since the power supplied, it is ineffective for counting accumulation time until 24 hours elapse.
- F-2: When condensing fan motor accumulation time expires about 6 years (2044days), 'F-2' and chamber temperature are alternately displayed.
Unit starts counting accumulation time every 24 hours elapse since a power is supplied.
Audible alarm and remote alarm do not activate.
Input '410' in F06 and press CAL key to reset accumulation time to '0'.
If a unit forcibly turns off before 24 hours elapse since the power supplied, it is ineffective for counting accumulation time until 24 hours elapse.
Note) If notice of fan motor life is set to '0' (Not notify) in F43, 'F-2' will not emit.

Error code priority:

High	E03/E04 (Open/short circuit in defrost sensor)
	E05/E06 (Open/short circuit in comp. sensor)
	E10 (Compressor temperature is abnormal)
	E13/E14 (Open/short circuit in alarm sensor)
	E15/E16 (Disable to detect high/low temp. alarm)
	E17/E18 (Disable to detect high/low temp. alarm)
	E2P (Disable to memorize setting value)
	F-1 (Notice of battery life)
Low	F-2 (Notice of condensing fan motor life)



4. Alarms

- High temp. alarm:** When one of bottle temperature which is higher than the other between upper and lower bottle is equal or higher than SV_H (high temp. alarm set temperature) + 0.09, ALARM lamp and LED digits blink, audible alarm sounds intermittently, remote alarm turns on.
When one of bottle temperature which is higher than the other between upper and lower bottle is equal or lower than SV_H , ALARM lamp goes off, LED digits stops blinking, audible alarm silences, remote alarm turns off.
Press BUZZER key to cancel operations for audible alarm and remote alarm during unit is in alarming condition.
High temp. alarm setting temperature is changeable in F01.
(Factory default: 6°C)
- Low temp. alarm:** When one of bottle temperature which is lower than the other between upper and lower bottle is lower than SV_L (low temp. alarm set temperature) -0.09, ALARM lamp and LED digits blink, audible alarm sounds intermittently, remote alarm turns on.
When one of bottle temperature which is lower than the other between upper and lower bottle is equal or higher than SV_L , ALARM lamp goes off, LED digits stops blinking, audible alarm silences, remote alarm turns off.
Press BUZZER key to cancel operations for audible alarm and remote alarm during unit is in alarming condition.
Low temp. alarm setting temperature is changeable in F02.
(Factory default: 2°C)
- Door alarm:** When a door leaves open, DOOR lamp illuminates and audible alarm sounds intermittently after delay time elapses. Audible alarm does not link with remote alarm. Press BUZZER key to cancel an operation for audible alarm. (Ring Back does not activate).
- Power failure alarm:** When a power switch is in off position or a power is interrupted, ALARM lamp blinks, LED digits go off, audible alarm sounds intermittently, remote alarm turns on.
Operations for audible alarm and remote alarm are not cancelled by pressing BUZZER key.
Unit will start an operation with initial setting after it returns from a power failure. Remote alarm will not turn on.

5. Representative functions

Auto Return: If there are no key operations for 90 seconds during calibration mode and function mode, unit will automatically return to chamber temperature display.

Ring Back: Audible alarm will sound again after predetermined setting time elapses if BUZZER key is pressed to cancel operation for audible alarm.

Ring Back time is changeable in F25. (Factory default: 30 minutes)

Example display of sensor temperature:

- When upper sensor temp. is +5.4°C => Display indicates as '5.4'
- When lower sensor temp. is -5.4°C => Display indicates as '-5.4'
- When lower sensor temp. is -20.3°C => Display indicates as '20.3'
- When defrost sensor temp. is -5.4°C => Display indicates as '-5.4'
- When defrost sensor temp. is -20.3°C => Display indicates as '20.3'
- When comp. sensor temp. is +36.2°C => Display indicates as '36.2'
- When alarm sensor temp. is +5.4°C => Display indicates as '05.4'

Note) When comp. sensor temp. is higher than 99.9°C, display will indicate as '99.9'.

Battery accumulation time:

Battery accumulation time is displayed in F03.

When battery accumulation time expires 2.5 years, display indicates as '02.5'

When battery accumulation time expires about 3 years, 'F-1' is displayed.

Input '409' and press CAL key to reset non-volatile memory to '00.0'.

Condensing fan motor accumulation time:

Condensing fan motor accumulation time is displayed in F32.

When condensing fan motor accumulation time expires 5.3 years, display indicates as '05.3'.

When notice of fan motor life is selected to '001' (notify) in F43 and accumulation time expires about 6 years, 'F-2' is displayed.

Input '410' and press CAL key to reset non-volatile memory to '00.0'.

Display of ROM version:

Installed ROM version can be checked in F30.

When a ROM version is 1.00, display indicates as '1.00'.

6. Function mode (F-mode)

- F01: Setting of high temp. alarm
- F02: Setting of low temp. alarm
- F03: Display of battery accumulation time
- F04: Setting of door alarm delay time
- F06: Input of service code and reset of accumulation time
- F09: Compressor continuous running mode (Unused)
- F11: PCB test mode (Unused)
- F12: Display of upper sensor temperature
- F13: Display of lower sensor temperature
- F14: Display of defrost sensor temperature
- F15: Display of comp. sensor temperature
- F16: Display of alarm sensor temperature
- F17: Setting of model code and data initialization in non-volatile memory
- F21: Setting of communication ID
- F22: Setting of communication mode
- F25: Setting of Ring Back time
- F30: Display of ROM version
- F32: Display of condensing fan motor accumulation time
- F33: Setting of temperature to start defrosting
- F34: Setting of temperature to terminate defrosting
- F35: Defrost operation check mode (Unused)
- F36: Display of frequency of defrosting
- F37: High temp. alarm operation check (Unused)
- F38: Display of setting temperature
- F43: Notice of condensing fan motor life
- F44: Setting of temperature for low temp. cycle
- F45: Action linkage between door and illumination

How to set: (1) Press  key for 5 seconds in chamber temperature is displayed.
 (2) 'F00' is displayed. Input function code by pressing  key and  key.
 (3) Press CAL key to step to required function mode.

- | | | |
|------|-------------|---|
| F01: | [Purpose] | Setting of high temp. alarm |
| | [Operation] | Input 'F01' and press CAL key to display '06.0' (Factory default).
Input required value by pressing  key and  key.
Press CAL key to memorize the value and unit will return to chamber temperature display.
(Range: 05.0 ~ 09.9) |
| F02: | [Purpose] | Setting of low temp. alarm |
| | [Operation] | Input 'F02' and press CAL key to display '02.0' (Factory default).
Input required value by pressing  key and  key.
Press CAL key to memorize the value and unit will return to chamber temperature display.
(Range: 01.0 ~ 04.0) |
| F03: | [Purpose] | Display of battery accumulation time |
| | [Operation] | Input 'F03' and press CAL key to display alternately F03 with battery accumulation time. Press CAL key to return to chamber temperature display.
Note) If accumulation time is less than 36days, '00.0' will be displayed. |

F04:	[Purpose] [Operation]	Setting of door alarm delay time Input F04 and press CAL key to display '002' (Factory default). Change to required value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. (Range: 000~ 012)
F06:	[Purpose] [Operation] [Reset]	Input of service code, reset of accumulation time Input 'F06' and press CAL key to display '000' (Factory default). <u>Battery accumulation time:</u> Change a value to '409' by pressing ▲ key and ►► key. Press CAL key to reset battery accumulation time and unit will return to chamber temperature display. <u>Condensing fan motor accumulation time:</u> Change a value to '410' by pressing ▲ key and ►► key. Press CAL key to reset condensing fan motor accumulation time and unit will return to chamber temperature display.
F12:	[Purpose] [Operation] [Cancel]	Display of upper sensor temperature Input 'F12' and press CAL key to display 'F12' alternately with current upper sensor temperature. In 'F12' displays alternately with current upper sensor temperature, press CAL key to return to chamber temperature display.
F13:	[Purpose] [Operation] [Cancel]	Display of lower sensor temperature Input 'F13' and press CAL key to display 'F13' alternately with current lower sensor temperature. In 'F13' displays alternately with current lower sensor temperature, press CAL key to return to chamber temperature display.
F14:	[Purpose] [Operation] [Cancel]	Display of defrost sensor temperature Input 'F14' and press CAL key to display 'F14' alternately with current defrost sensor temperature. In 'F14' displays alternately with current defrost sensor temperature, press CAL key to return to chamber temperature display.
F15:	[Purpose] [Operation] [Cancel]	Display of comp. sensor temperature Input 'F15' and press CAL key to display 'F15' alternately with current comp. sensor temperature. In 'F15' displays alternately with current comp. sensor temperature, press CAL key to return to chamber temperature display.
F16:	[Purpose] [Operation] [Cancel]	Display of alarm sensor temperature Input 'F16' and press CAL key to display 'F16' alternately with current alarm sensor temperature. In 'F16' displays alternately with current alarm sensor temperature, press CAL key to return to chamber temperature display.

- F17: [Purpose] Setting of model code, data initialization in non-volatile memory
 [Operation] Input 'F17' and press CAL key to display current model code.
 Change to '001' (Model code for MBR-305GR/305D/305DR) by pressing ▲ key and ►► key.
 Press CAL key to memorize the value in non-volatile memory and unit will return to chamber temperature display.

Note) It is necessary to set model code when PCB is replaced.

[Initial values in non-volatile memory]

Zero adjustment for upper sensor	: 000
Zero adjustment for lower sensor	: 000
Temperature to start defrosting	: -15°C
Temperature to terminate defrosting	: 5°C
Temperature for low temp cycle	: 2°C
Action linkage between door and illumination	: 0 (Not linked)
High temp. alarm temperature	: 6°C
Low temp. alarm temperature	: 2°C
Door alarm delay time	: 2 minutes
Span adjustment for upper sensor	: 100
Span adjustment for lower sensor	: 100
Ring Back time	: 30 minutes
Communication ID	: 000
Communication mode	: 000
Non-volatile memory check data	:
Battery accumulation time	: 0
Condensing fan motor accumulation time	: 0
Notice of condensing fan motor life	: OFF

- F21: [Purpose] Setting of serial communication ID
 [Operation] Input 'F21' and press CAL key to display '000' (Factory default).
 Change a value by pressing ▲ key and ►► key.
 Press CAL key to memorize the value and unit will return to chamber temperature display.
 (Range: '001' ~ '255')

[Serial communication data]

Mean between upper and lower sensor temp.	: -60.0 ~ +60.0 (°C)
Upper sensor temperature	: -60.0 ~ +60.0 (°C)
Lower sensor temperature	: -60.0 ~ +60.0 (°C)
Defrost sensor temperature	: -60.0 ~ +60.0 (°C)
Power failure	: 0/100 (Yes/No)
Comp. sensor temperature	: -60.0 ~ +60.0 (°C)
Door status	: 0/100 (Open/Close)
Set temp. for temp. control PCB	: -60.0 ~ +60.0 (°C)
Alarm sensor temperature	: -60.0 ~ +60.0 (°C)
High temp. alarm set temperature	: 5.0 ~ 9.9 (°C)
Low temp. alarm set temperature	: 1.0 ~ 4.0 (°C)

F22:	[Purpose]	Setting of serial communication mode
	[Operation]	Input 'F22' and press CAL key to display '000' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. Control mode (The 3rd digit) 0: Local (Factory default) 1: Remote Baud rate (The 2nd digit) 0: 2400 bps (Factory default) 1: 4800 bps 2: 9600 bps
F25:	[Purpose]	Setting of Ring Back time
	[Operation]	Input 'F25' and press CAL key to display '030' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. (Range: '010' ~ '099')
F30:	[Purpose]	Display of ROM version
	[Operation]	Input 'F30' and press CAL key to display F30 alternately with 'X.XX' (current ROM version). Press CAL key to return to chamber temperature display.
F32:	[Purpose]	Display of condensing fan motor accumulation time
	[Operation]	Input 'F32' and press CAL key to display F32 alternately with 'XX.X' (condensing fan motor accumulation time). Press CAL key to return to chamber temperature display. Note) If an accumulation time is less than 36days, '00.0' will be displayed.
F33:	[Purpose]	Setting of temperature which starts defrosting
	[Operation]	Input 'F33' and press CAL key to display '-12.0' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. (Range: '-10.0' ~ '-19.9')
F34:	[Purpose]	Setting of temperature which terminates defrosting
	[Operation]	Input 'F34' and press CAL key to display '05.0' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. (Range: '0.0' ~ '9.9')
F36:	[Purpose]	Display of frequency of defrosting
	[Operation]	Input 'F36' and press CAL key to display F36 alternately with frequency of defrosting (Maximum: 999) that has been counted since a power was supplied.
	[Reset]	Turn the power off or press ▲ key over 5 seconds to reset counting. When F36 and frequency of defrosting are alternately displayed, press CAL key to return to chamber temperature display.

F38:	[Purpose]	Display of setting temperature
	[Operation]	Input 'F38' and press CAL key to display F38 alternately with 'XX.X' (setting temperature). Press SET/CAL key to return to chamber temperature display.
	[Reset]	When F38 and setting temperature are alternately displayed, press CAL key to return to chamber temperature display.
F43:	[Purpose]	Notice of condensing fan motor life
	[Operation]	Input 'F43' and press CAL key to display '000' or '001'. Change to alternate value by pressing ▲ key. Press CAL key to memorize the value and unit will return to chamber temperature display. 000: Not notify 001: Notify
F44:	[Purpose]	Setting of temperature for low temp. cycle
	[Operation]	Input 'F44' and press CAL key to display '02.0' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. (Range: '000' ~ '030')
F45:	[Purpose]	Action linkage between door and illumination
	[Operation]	Input 'F45' and press CAL key to display '000' (Factory default). Change a value by pressing ▲ key and ►► key. Press CAL key to memorize the value and unit will return to chamber temperature display. 0 (1 st digit): Not linked 1 (1 st digit): Linked

7. Calibration mode (C-mode)

- C00: Unit will return to chamber temperature display (Unused)
- C01: Zero calibration of upper sensor
- C02: Zero calibration of lower sensor
- C03: Span calibration of upper sensor
- C04: Span calibration of lower sensor

How to set: (1) When a chamber temperature displays, press CAL key for 5 seconds
(2) 'C00' will be displayed.
Input calibration code by pressing ▲ key and ►► key.
(3) Press CAL key to activate calibration mode.

- C01: [Purpose] Zero calibration of upper sensor
 [Operation] Press UPPER/LOWER key to display upper sensor temperature (Range: -1.5~+1.5°C). If upper sensor temperature is out of range, unit will not commence calibration and buzzer tone will emit.
 Put upper sensor into fully stirred ice water and leave it until temperature display stabilizes.
 Press CAL key for 5 seconds to display 'C00'.
 Change to 'C01' by pressing ▲ key.
 Press CAL key to terminate calibration and to return to chamber temperature display.
- Note) Ensure to repeat the procedure until a displayed temperature should be almost 0°C.
- C02: [Purpose] Zero calibration of lower sensor
 [Operation] Press UPPER/LOWER key to display lower sensor temperature (Range: -1.5~+1.5°C). If lower sensor temperature is out of range, unit will not commence calibration and buzzer tone (1 second) will emit.
 Put upper sensor into fully stirred ice water and leave it until temperature display stabilizes.
 Press CAL key for 5 seconds to display 'C00'.
 Change to 'C02' by pressing ▲ key.
 Press CAL key to terminate calibration and to return to chamber temperature display.
- Note) Ensure to repeat the procedure until a displayed temperature should be almost 0°C.
- C03: [Purpose] Span calibration of upper sensor
 [Operation] Press CAL key for 5 seconds to display 'C00'.
 Change to 'C03' by pressing ▲ key.
 Press CAL key to display lower sensor temperature.
 Change to a correct value by pressing ▲ key and ►► key.
 (Range: +3.0 ~ +5.9°C)
 If a value deviates from the range, unit will not commence calibration and buzzer tone (1 second) will emit.
 Press CAL key to terminate calibration and to return to chamber temperature display.
- C04: [Purpose] Span calibration of lower sensor
 [Operation] Press CAL key for 5 seconds to display 'C00'.
 Change to 'C03' by pressing ▲ key.
 Press CAL key to display lower sensor temperature.
 Change to a correct value by pressing ▲ key and ►► key.
 (Range: +3.0 ~ +5.9°C)
 If a value deviates from the range, unit will not commence calibration and buzzer tone (1 second) will emit.
 Press CAL key to terminate calibration and to return to chamber temperature display.

8. Temperature control

(1) Low temperature cycle

When alarm sensor temperature is lower than +2°C, alarm relay turns on.

(Compressor turns off and heater is energized)

When alarm sensor temperature is higher than +2°C, alarm relay turns off.

(Compressor and heater are controlled by temperature control PCB)

Setting temperature for low temp. cycle is changeable in F44.

There is 3 minutes to restart compressor after it stopped once, even if it meets condition that compressor would start soon.

(2) When alarm sensor fails during low temperature cycle

Upper/lower sensor will be used instead of alarm sensor.

When low temp. alarm emits, alarm relay turns on.

(Compressor turns off and heater is energized)

When low temp. alarm is cancelled, alarm relay turns off.

(Compressor and heater are controlled by temperature control PCB)

(3) Compressor protection

When condensing fan motor is locked, compressor will turn off to prevent discharge pressure in compressor from being increased.

When comp. sensor temperature is higher than +57°C, compressor will turn off.

When comp. sensor temperature is lower than +45°C, compressor will turn on.

9. Defrosting

By detecting a defrost sensor temperature in evaporating pipe and controlling compressor and heater, unit will perform defrosting around evaporator.

During defrosting, a unit will display chamber temperature and 'dF' alternately.

(1) Forcible defrosting

When a defrost sensor temperature is lower than -12°C (Factory default), a unit will forcibly commence defrosting.

When a defrost sensor temperature is higher than +5°C (Factory default) during defrosting, a unit will terminate defrosting.

A temperature that commences defrosting is changeable in F33.

A temperature that terminates defrosting is changeable in F34.

(2) Count of frequency of defrosting

Count will be checked in F36.

10. Delay time

- (1) Compressor delay time (3 minutes, fixed)
When a unit cycle runs, it takes 3 minutes to turn on compressor after it was turned off.
There are no delay time after a unit was energized (reset).
- (2) Door alarm delay time (2 minutes, factory default)
There is delay time to emit audible alarm when a door leaves open.
Delay time is changeable in F04.

11. Remote alarm contact

	CN3	
	Between #1 and #2 (N.O.)	Between #1 and #3 (N.C.)
Normal	Open	Close
In alarm	Close	Open

12. Settings after a power is supplied (Power on reset)

Alarms	: Ineffective
Compressor	: Turns off
Defrosting	: Ineffective
Compressor protection	: Ineffective
Remote alarm	: Turns off
Ring Back	: Ineffective
Door alarm delay time	: 2 minutes
Timer	: Reset
Setting data	: Read by non-volatile memory

13. Lamp operation

- (1) Display PCB
 - DP51: (ALARM) Red lamp blinks when a unit is in alarming condition.
 - DP52: (DOOR) Red lamp illuminates when a door leaves open.
 - DP54: (Upper limit temp.) Green lamp illuminates when upper sensor temperature is displayed.
 - DP55: (Lower limit temp.) Green lamp illuminates when lower sensor temperature is displayed.

(2) Main PCB

DP1: (Alarming operation)

Orange lamp illuminates when a unit is not in alarming condition.

Orange lamp goes off when high/low temp. alarm emit or sensor is failed.

DP2: (Temperature control)

Green lamp illuminates when a compressor turns off.

Green lamp goes off when a temp. control PCB activates.

DP3: (Illumination)

Red lamp illuminates when fluorescent lamp illuminates.

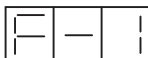
Red lamp goes off when fluorescent lamp goes off.

DP4: (Heater operation)

Yellow lamp illuminates when defrost heater turns on.

Yellow lamp goes off when defrost heater turns off.

14. Examples of LED display

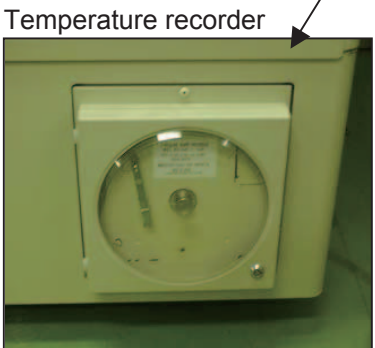
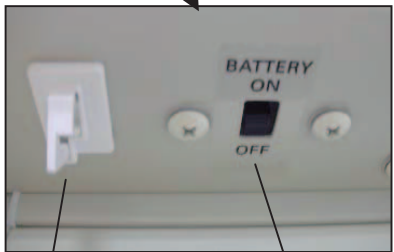
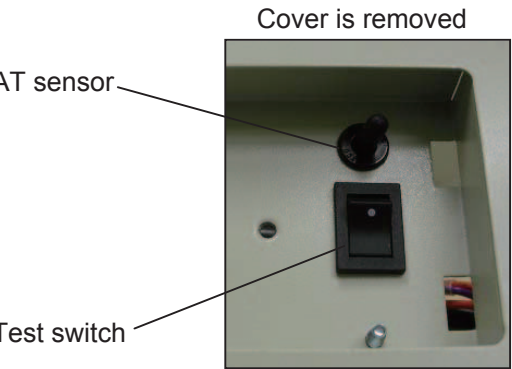
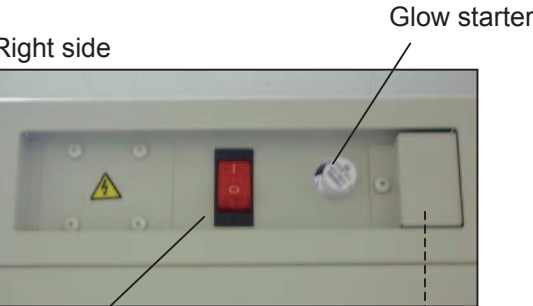
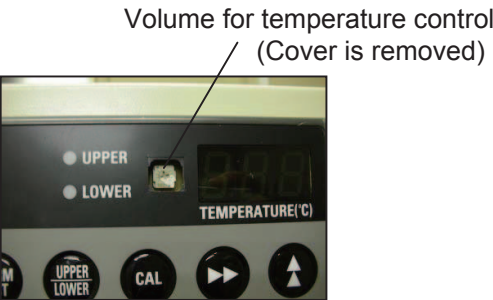
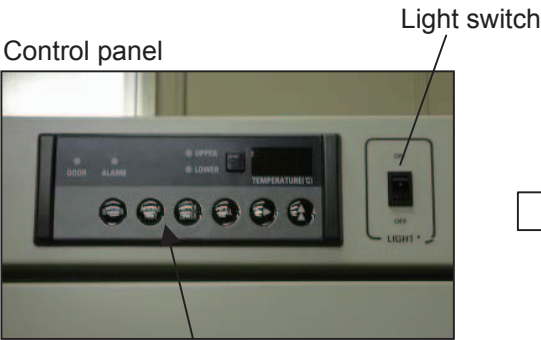
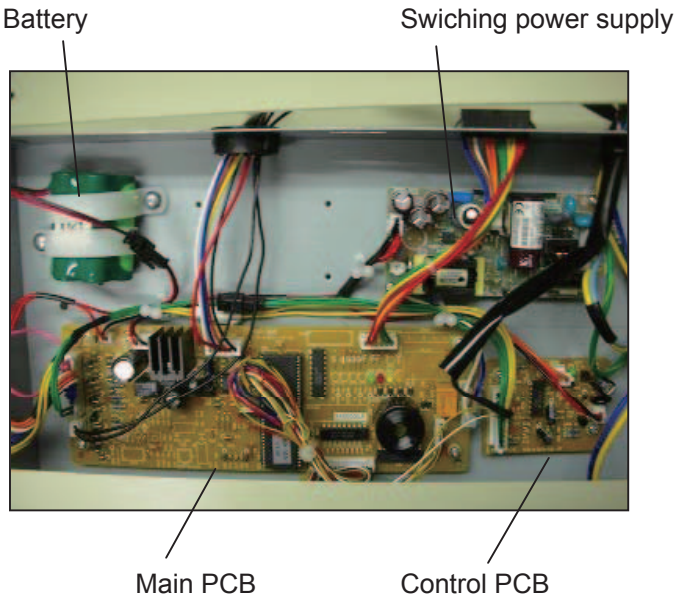
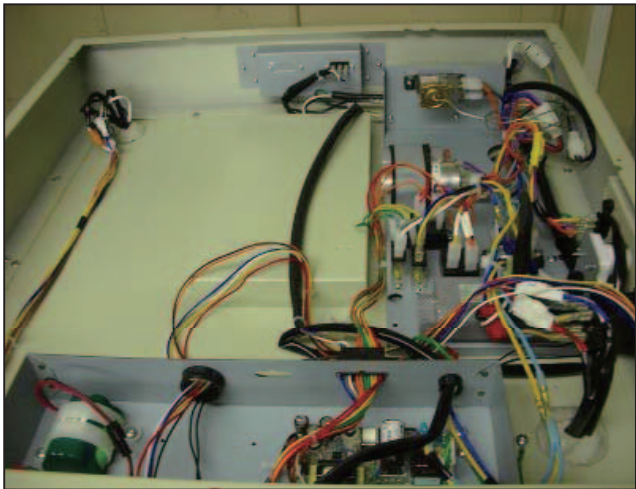
Chamber temp.	4.0°C		Temp. to start defrosting	-12.0	
Function mode	F03		Forcible defrosting	dF	
Calibration mode	C01		Error code	E01	
Service code	409		Battery life	F-1	
Setting value	004				

15. Buzzer tone

Alarms	: Intermittent tone
Key operation	: Short tone
Set value memorization	: Short tone
Out of setting range	: 1 second alarming tone
Power failure	: intermittent tone

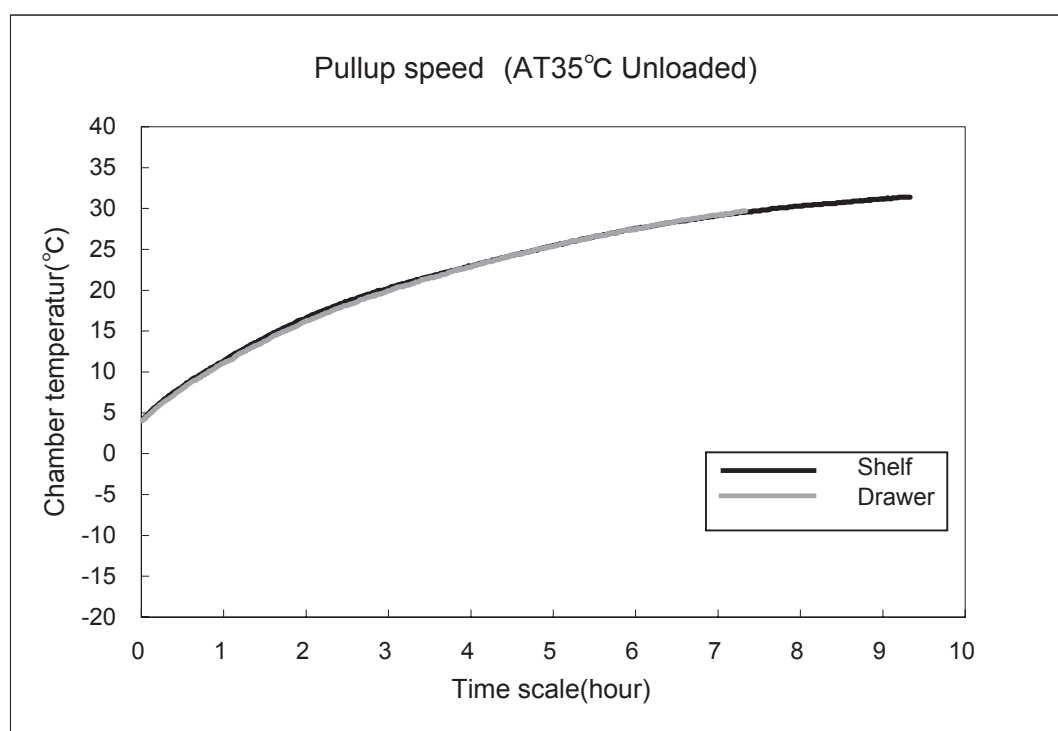
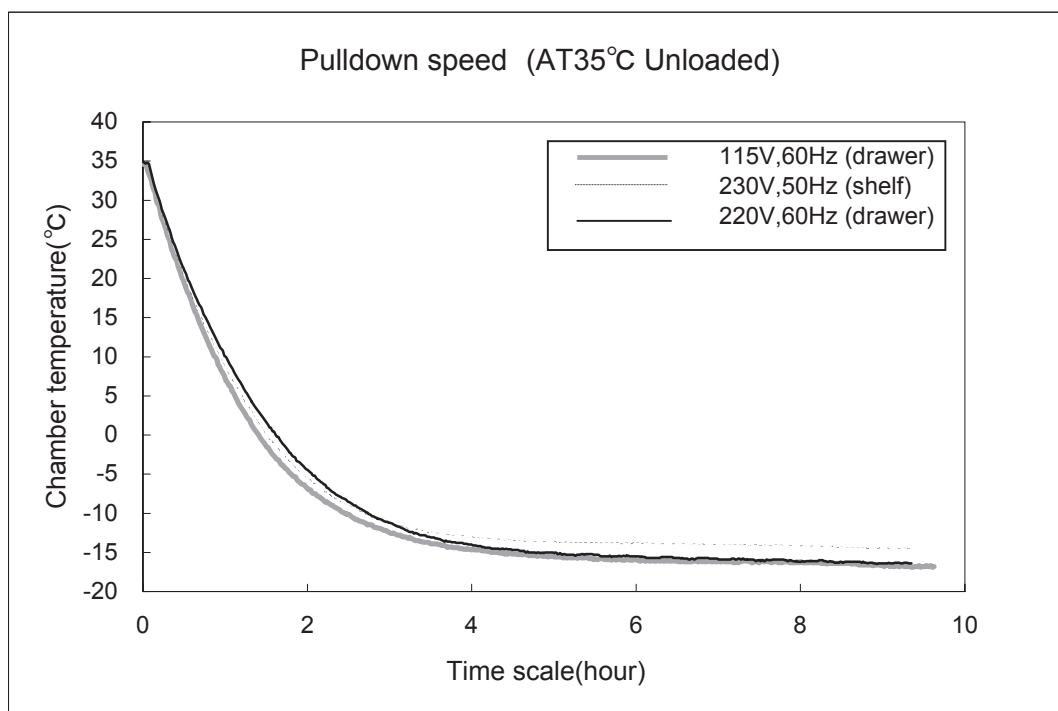
Parts layout

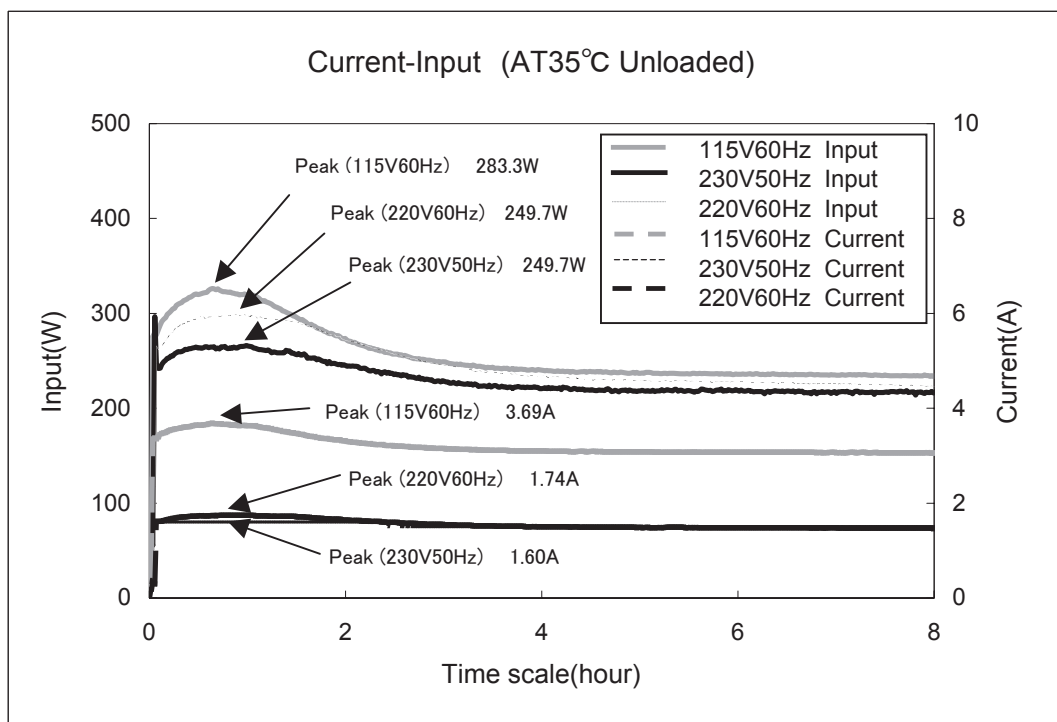
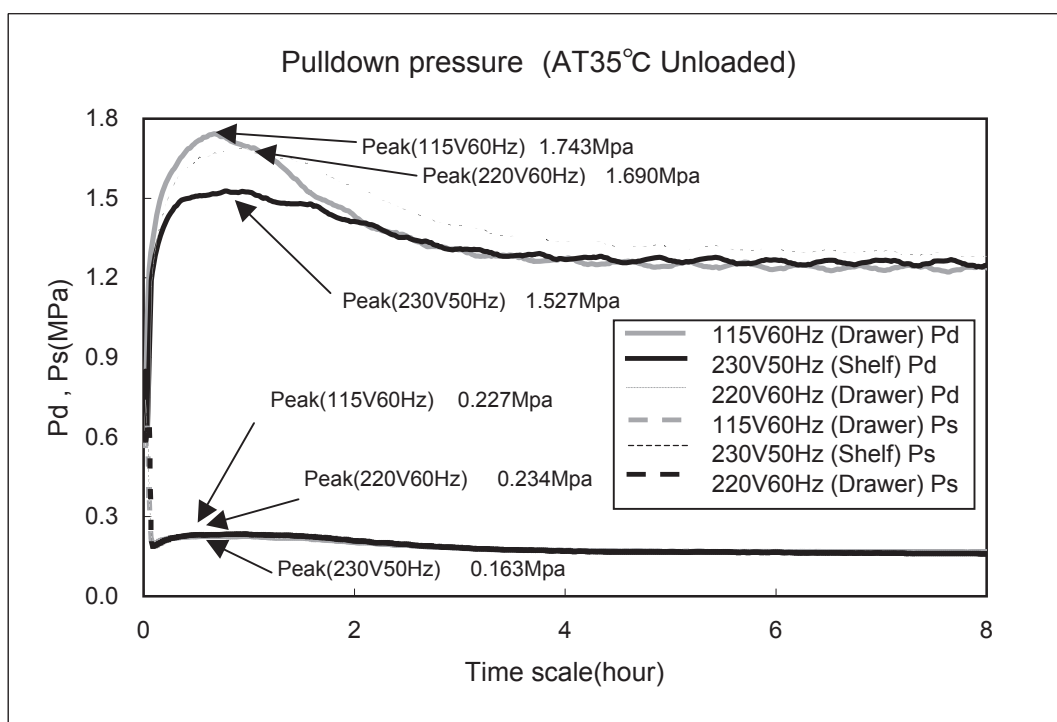
Electric components (Top)



Test data

Note) Following data are the reference only.





Temperature uniformity (15points measured)

Note) Following data are the reference only.

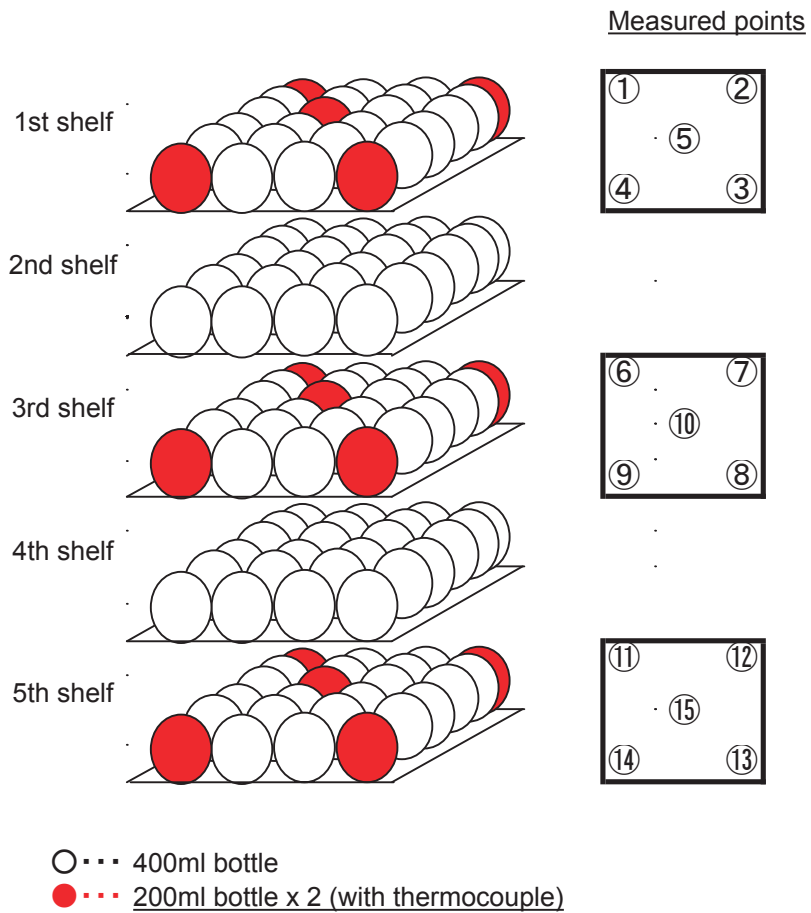
<Condition>

Power supply: 110/115V60Hz, 220~240V50Hz, 220V60Hz

SV: 4°C

AT: 20°C/30°C

Load: 24bottles x 5shelves = 120 bottles



Temperature uniformity (15points measured)

Unit:°C

	Ambient temperature 20°C											
	115V60Hz				230V50Hz				220V60Hz			
Point	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	4.8	4.4	4.57	±0.20	4.8	4.6	4.71	±0.10	4.8	4.6	4.73	±0.10
②	4.2	3.9	4.06	±0.15	4.6	4.4	4.51	±0.10	4.5	4.3	4.42	±0.10
③	4.1	3.8	3.95	±0.15	4.3	4.1	4.20	±0.10	4.3	4.2	4.25	±0.05
④	4.2	3.7	3.93	±0.25	4.8	4.4	4.61	±0.20	4.4	4.2	4.30	±0.10
⑤	4.3	4.0	4.16	±0.15	4.5	4.3	4.45	±0.10	4.6	4.5	4.53	±0.05
⑥	4.4	4.0	4.17	±0.20	4.6	4.4	4.51	±0.10	4.5	4.3	4.42	±0.10
⑦	3.8	3.4	3.64	±0.20	4.4	4.2	4.29	±0.10	4.1	3.9	4.01	±0.10
⑧	3.6	3.1	3.33	±0.25	4.1	3.7	3.87	±0.20	3.7	3.5	3.60	±0.10
⑨	3.8	3.3	3.54	±0.25	4.3	3.5	3.93	±0.40	4.0	3.8	3.91	±0.10
⑩1/2H	3.7	3.3	3.49	±0.20	4.2	3.9	4.03	±0.15	4.1	3.9	3.99	±0.10
⑪	4.3	3.9	4.12	±0.20	4.5	4.3	4.40	±0.10	4.5	4.3	4.39	±0.10
⑫	3.5	3.1	3.29	±0.20	4.2	4.0	4.08	±0.10	4.0	3.8	3.92	±0.10
⑬	3.4	2.9	3.13	±0.25	4.1	3.2	3.61	±0.45	3.6	3.4	3.55	±0.10
⑭	3.6	3.2	3.42	±0.20	4.4	3.4	3.86	±0.50	4.0	3.8	3.87	±0.10
⑮	3.6	3.2	3.38	±0.20	3.9	3.8	3.84	±0.05	4.0	3.8	3.91	±0.10
Average	-	-	3.75	-	-	-	4.19	-	-	-	4.12	-

	Ambient temperature 30°C											
	115V60Hz				230V50Hz				220V60Hz			
Point	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	5.1	4.7	4.86	±0.20	4.9	4.7	4.78	±0.10	5.0	4.6	4.81	±0.20
②	4.4	4.0	4.21	±0.20	4.7	4.5	4.59	±0.10	4.5	4.3	4.41	±0.10
③	4.3	3.9	4.07	±0.20	4.3	4.1	4.18	±0.10	4.3	4.0	4.15	±0.15
④	4.3	3.7	4.04	±0.30	4.9	4.5	4.68	±0.20	4.3	4.0	4.13	±0.15
⑤	4.7	4.3	4.51	±0.20	4.7	4.4	4.54	±0.15	4.7	4.4	4.58	±0.15
⑥	4.6	4.1	4.34	±0.25	4.6	4.4	4.50	±0.10	4.5	4.2	4.30	±0.15
⑦	3.9	3.5	3.70	±0.20	4.4	4.1	4.25	±0.15	4.0	3.8	3.89	±0.10
⑧	3.4	3.0	3.15	±0.20	3.9	3.5	3.70	±0.20	3.4	3.2	3.28	±0.10
⑨	3.8	3.2	3.53	±0.30	4.1	3.3	3.68	±0.40	3.7	3.4	3.58	±0.15
⑩1/2H	3.6	3.2	3.40	±0.20	4.0	3.7	3.83	±0.15	4.0	3.6	3.76	±0.20
⑪	4.6	4.2	4.36	±0.20	4.6	4.4	4.51	±0.10	4.6	4.3	4.48	±0.15
⑫	3.5	3.1	3.32	±0.20	4.2	4.0	4.12	±0.10	4.1	3.9	3.95	±0.10
⑬	3.3	2.8	3.00	±0.25	4.0	3.0	3.52	±0.50	3.4	3.1	3.29	±0.15
⑭	3.7	3.2	3.43	±0.25	4.2	3.2	3.73	±0.50	3.8	3.5	3.60	±0.15
⑮	3.6	3.2	3.43	±0.20	3.9	3.7	3.78	±0.10	3.8	3.6	3.71	±0.10
Average	-	-	3.82	-	-	-	4.16	-	-	-	3.99	-

PRECAUTIONS FOR SAFE OPERATION

It is imperative that the user complies with this manual as it contains important safety advice.

Items and procedures are described so that you can use this unit correctly and safely. If the precautions advised are followed, this will prevent possible injury to the user and any other person.

Precautions are illustrated in the following way:

WARNING

Failure to observe WARNING signs could result in a hazard to personnel possibly resulting in serious injury or death.

CAUTION

Failure to observe CAUTION signs could result in injury to personnel and damage to the unit and associated property.

Symbol shows;

 this symbol means caution.

 this symbol means an action is prohibited.

 this symbol means an instruction must be followed.

Be sure to keep this manual in a place accessible to users of this unit.

< Label on the unit >



This mark is labeled on the cover in which the electrical components of high voltage are enclosed to prevent the electric shock.

The cover should be removed by a qualified engineer or a service personnel only.

PRECAUTIONS FOR SAFE OPERATION

WARNING

-  **Do not use the unit outdoors.** Current leakage or electric shock may result if the unit is exposed to rain water.
-  **Only qualified engineers or service personnel should install the unit.** The installation by unqualified personnel may cause electric shock or fire.
-  **Install the unit on a sturdy floor and take an adequate precaution to prevent the unit from turning over.** If the floor is not strong enough or the installation site is not adequate, this may result in injury from the unit falling or tipping over.
-  **Never install the unit in a humid place or a place where it is likely to be splashed by water.** Deterioration of the insulation may result which could cause current leakage or electric shock.
-  **Never install the unit in a flammable or volatile location.** This may cause explosion or fire.
-  **Never install the unit where acid or corrosive gases are present** as current leakage or electric shock may result due to corrosion.
-  **Always ground (earth) the unit to prevent electric shock.** If the power supply outlet is not grounded, it will be necessary to install a ground by qualified engineers.
-  **Never ground the unit through a gas pipe, water main, telephone line or lightning rod.** Such grounding may cause electric shock in the case of an incomplete circuit.
-  **Connect the unit to a power source as indicated on the rating label attached to the unit.** Use of any other voltage or frequency other than that on the rating label may cause fire or electric shock.
-  **Never store volatile or flammable substances** in this unit if the container cannot be sealed. These may cause explosion or fire.
-  **Do not insert metal objects such as a pin or a wire into any vent, gap or any outlet on the unit.** This may cause electric shock or injury by accidental contact with moving parts.
-  **Use this unit in safe area when treating the poison, harmful or radiate articles.** Improper use may cause bad effect on your health or environment.
-  **Turn off the power switch (if provided) and disconnect the power supply to the unit prior to any repair or maintenance** of the unit in order to prevent electric shock or injury.
-  **Do not touch any electrical parts (such as power supply plug) or operate switches with a wet hand.** This may cause electric shock.

PRECAUTIONS FOR SAFE OPERATION



WARNING

-  **Ensure you do not inhale or consume medication or aerosols** from around the unit at the time of maintenance. These may be harmful to your health.
-  **Never splash water directly onto the unit** as this may cause electric shock or short circuit.
-  **Never put containers with liquid on the unit** as this may cause electric shock or short circuit when the liquid is spilled.
-  **Never bind, process, or step on the power supply cord, or never damage or break the power supply plug.** A broken supply cord or plug may cause fire or electric shock.
-  **Do not use the supply cord if its plug is loose.** Such supply cord may cause fire or electric shock.
-  **Never disassemble, repair, or modify the unit yourself.** Any such work carried out by an unauthorized person may result in fire, or electric shock or injury due to a malfunction.
-  **Disconnect the power supply plug if there is something wrong with the unit.** Continued abnormal operation may cause electric shock or fire.
-  **When removing the plug from the power supply outlet, grip the power supply plug, not the cord.** Pulling the cord may result in electric shock or fire by short circuit.
-  **Disconnect the power supply plug** before moving the unit. Take care not to damage the power cord. A damaged cord may cause electric shock or fire.
-  **Disconnect the power plug when the unit is not used for long periods.** Keeping the connection may cause electric shock, current leakage, or fire due to the deterioration of insulation.
-  **If the unit is to be stored unused in an unsupervised area for an extended period, ensure that children do not have access and that doors cannot be closed completely.**
-  **The disposal of the unit should be accomplished by appropriate personnel.** Remove doors to prevent accidents such as suffocation.
-  **Do not put the packing plastic bag within reach of children** as suffocation may result.